



## The impact of climate change on child's health: diarrhoeal diseases in developing countries

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Global Climate Change

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## Abstract

Evidence indicates that the global climate is changing, resulting in elevated temperatures, rising sea levels, and drought. Moreover, a change in world climate would have wide-ranging, mostly adverse, consequences for human health. Most of the anticipated health impacts would entail increased rates of illnesses and death from familiar causes.

Specially, children have increased vulnerability compared with the rest of the population, and they are one of the groups most likely to experience adverse health caused by environmental change.

In specific, Climate change is predicted to increase the incidence and severity of diarrhoeal disease which is one of the three main causes of child death globally. And is primarily attributable to environmental factors, specifically contaminated food and drinking water, and is affected by changing temperature, rainfall and precipitation events.

Furthermore, In order to tackle the challenge of global climate change and child health, Prevention strategies for reduction of greenhouse gas (GHG) levels in the global system are needed and contribution can be made at both the national and global levels to address the overall health impacts of climate change, and to the promotion of children's needs and rights.

## Introduction

Global climate is changing in ways that have major implications for human life, results from interactions between greenhouse gases, the earth's atmosphere, and the sun. The main greenhouse gases are carbon dioxide and methane. These, along with nitrogen oxides, sulfur oxides, ozone, and halocarbons, have been increasing since the early industrial revolution, owing principally to humankind's rapidly increasing combustion of fossil fuels along with increases in deforestation, irrigated agriculture <sup>1</sup>.

Moreover, Global warming accelerates the hydrologic cycle <sup>2</sup>. As heat accumulates in the ocean, water evaporates and sea ice melts. This increases the intensity and frequency of precipitation, leading to more flash floods <sup>3,4</sup>. Enhanced evaporation reduces soil moisture elsewhere, inducing longer droughts <sup>5</sup>.

Moreover, Extreme weather events such as heavy precipitation, floods, droughts, and cyclones have increased in frequency, duration, and intensity in some regions over the past century <sup>6</sup>. This trend will continue with climate change <sup>7</sup>. Earth is undergoing rapid, global climate change, global surface temperatures have increased at a rate near 0.6°C per century; although there remains uncertainty about how extensively the climate will change in the future. Temperatures and sea level will continue to rise throughout the 21st century <sup>8,9,10</sup>. Even if GHG emissions were reduced, the planet would continue to warm for decades until the energy stored in the system equilibrates <sup>11</sup>.

Furthermore, a change in world climate would have wide-ranging, mostly adverse, consequences for human health. Most of the anticipated health impacts would entail increased rates of illnesses and death from familiar causes. In addition, climate change is a long-term phenomenon with potentially unpredictable, significant and lasting effects on the environment and on humans <sup>12</sup>. Specifically, children have increased vulnerability compared with the rest of the population, and they are one of the groups most likely to experience adverse health caused by environmental change <sup>13</sup>. Due to children's rapid growth and cognitive and physiological development, they are exposed and more vulnerable to biological, chemical and physical environmental hazards compared to adults <sup>14</sup>. Moreover, exposure to the effects of climate change during childhood can cause immediate harm or damage that becomes evident much later in life, resulting in lasting imprints over lifetime and over generations <sup>15</sup>.

The direct impacts of natural disasters associated with climate change include extreme weather events such as droughts, floods, storms, and heat waves. Poses more of a challenge because those impacts typically result from changes in complex processes. They include alterations in the transmission of vector-borne infectious diseases, alterations in water quality and quantity, and changes in the productivity of agroecosystems, with the potential for displacement of vulnerable populations as a result of local declines in food supply or sea level rise. They can lead to adverse health outcomes and mortality <sup>16</sup>.

However, the indirect impacts prompt refugee camps that harbor infectious diseases and may also undermine life support systems, including water, forests, and other resources. The resulting social disruption, economic decline, and population displacement will negatively affect the psychosocial development of children.

Adding to above, WHO estimates that a third of the global burden of disease for children is due to modifiable factors in air, water, soil and food <sup>17</sup>. And approximately one in five deaths around

the world each year occurs in a child < 5 years of age, using the disability-adjusted life year (DALY) metric, > 88% of the existing burden of disease due to climate change occurs in children < 5 years of age in both developed and developing countries. This estimate is markedly higher than the pediatric proportion of the total burden of disease, which for children < 5 years of age is 5% in high-income countries and 31% in low- and medium-income countries<sup>18, 19</sup>.

The effects of climate change are predicted to be heavily concentrated in poorer populations, where the most major climate-sensitive health outcomes (malnutrition, diarrhoea and malaria) are already common. These diseases due to climate change mainly affect children in developing countries<sup>20</sup>.

In specific, Diarrheal disease is one of the three main causes of child death globally, estimated consistently to cause around 21–22% of all under-five deaths<sup>21</sup>. Climate change is predicted to increase the incidence and severity of diarrhoeal disease. A number of studies have shown links between temperature or rainfall events and acute gastrointestinal illness. Heavy rainfall may cause outbreaks of cryptosporidiosis, which causes severe diarrhea in children and can cause death in immunocompromised individuals<sup>22</sup>.

For example, during the period before the *El Niño* episode in Peru, admissions for childhood diarrhoea increased by 8 per cent per 1°C increase in mean temperature. Diarrhoeal diseases may increase by millions of cases worldwide with each degree of increase in ambient temperature above normal<sup>23</sup>.

Moreover, Rotavirus remains the leading cause of childhood diarrhoea. About 40 per cent of the hospitalizations for childhood diarrhoea worldwide are attributable to rotavirus and more than 0.6 million children under age five die every year from rotavirus infection, mainly in developing countries<sup>24</sup>. Factors associated with high temperature, low humidity and high river-level increased the incidence of rotavirus diarrhoea in Dhaka, Bangladesh<sup>25</sup>.

WHO defines diarrhea as the “passage of loose or watery stools at least three times in a 24 h period”, but emphasises the importance of change in stool consistency rather than frequency, and the usefulness of parental insight in deciding whether children have diarrhoea or not<sup>26</sup>. Blood in stool could indicate an acute diarrhoeal illnesses or dysentery, irrespective of frequency<sup>27,28</sup>.

Diarrhoeal disorders can further be divided into acute and chronic, allowing some categorisation of causes and associated management.

Diarrheal disease is primarily attributable to environmental factors, specifically contaminated food and drinking water, and is affected by changing temperature and precipitation events<sup>29</sup>.

And high temperatures increase the number of admissions for bacterial diarrheal disease<sup>30</sup>. High temperatures increase exposure to bacterial and parasitic diarrheal, and lengthen survival of bacteria such as enterotoxigenic *Escherichia Coli* in contaminated food. High temperatures may also indirectly affect behavior patterns, such as increased consumption of water and lax hygiene, which may promote diarrheal transmission<sup>31</sup>. Especially, Children must consume more water per body mass than adults. Greater consumption results in greater exposure to waterborne pathogens. Because children’s immune systems are less developed than those of adults, they are less effective in fighting pathogens. Waterborne microbes induce diarrhea and vomiting, which cause children to become dehydrated more quickly than adults. Because children rehydrate less

efficiently, they are more likely to die from dehydration. Similarly, children in regions affected by drought experience dehydration<sup>32, 33</sup>.

Moreover, Droughts have their largest impact on population health such as diarrhoeal diseases, which are associated with poor hygiene and may result from inadequate sanitation as water resources become depleted<sup>34</sup>. During droughts, water availability is diminished forcing people to access poorer quality water supply sources, and water quality is often degraded. An example is when people share water with livestock. A long drought followed by an intense rainfall generates exposure to the pathogen and multiple disease outbreaks.

Access to clean, safe water is still unavailable to more than 1 billion people worldwide. Climate change further threatens to severely impact the water quality and quantity. Limited access and poor quality of water affect child health through both chronic (e.g. arsenic) and acute (i.e. biological) exposures<sup>35</sup>.

### Case study in developing countries

Diarrhoea is one of the principal causes of mortality and morbidity especially in developing countries. 4 billion episodes of diarrhoea occurred each year, of which more than 90% occurred in developing countries<sup>36</sup>. Many investigations have reported that rainy season in tropical regions and ambient temperature could contribute to the incidence of diarrhoea<sup>37,38</sup>. (figure1), (figure2).

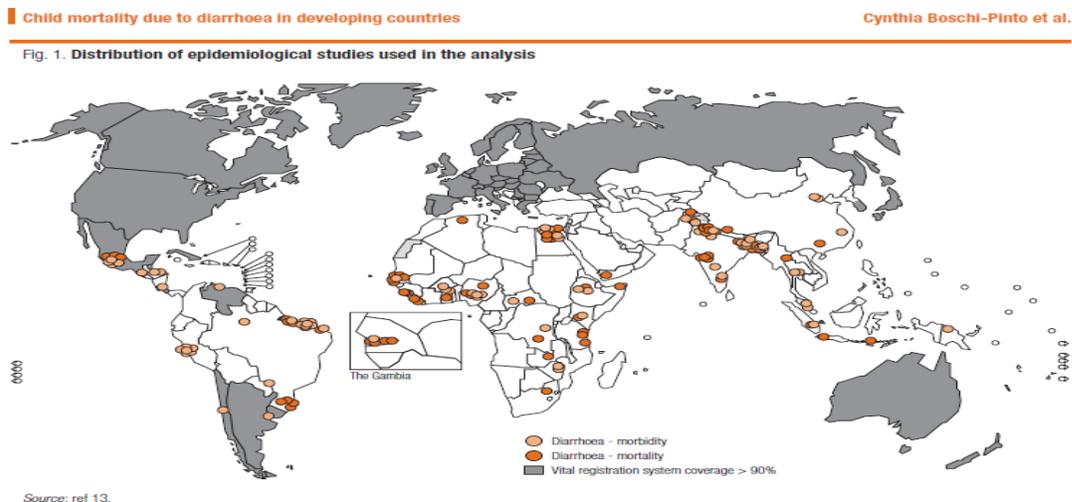
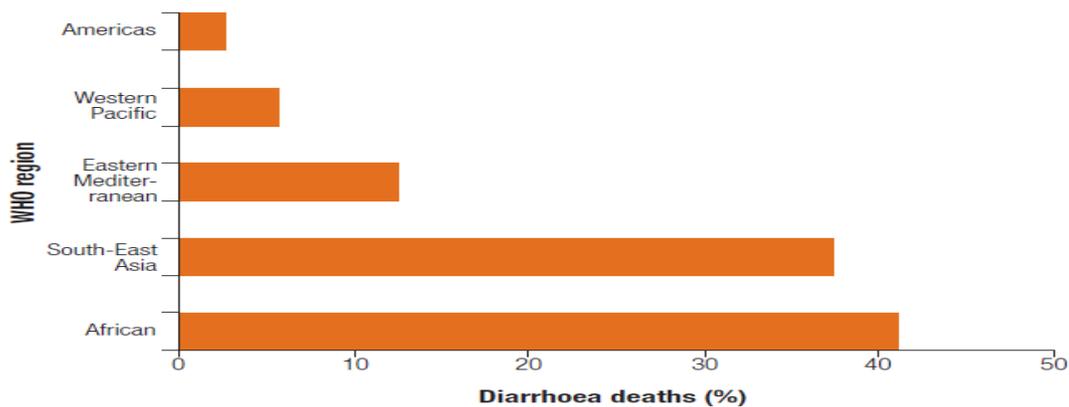


Fig. 2. Distribution of deaths due to diarrhoea in low- and middle-income countries in 5 WHO regions



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The effects of *El Niño* and ambient temperature and diarrhoeal diseases in Lima, Peru:

Study investigated whether the *El Niño* phenomenon and ambient temperature had an effect on the epidemiology of childhood diarrhea in Lima, Peru, between January, 1993, and November, 1998. Showed that the 1997–98 *El Niño* episodes increased the number of hospital admissions for diarrhoea to 200% above expected during the winter, and suggests that this concern is well founded. *El Niño* had an effect on hospital admissions for diarrhoea greater than that explained by regular seasonal variabilities in ambient temperature, and the excess increase in ambient temperature was the most important environmental variable affecting admissions.

The smaller increase per degree of increase in ambient temperature during the warmer seasons, and the greater *El Niño* effect during the cooler seasons, may be explained by changes in the causes of diarrhoea driven by ambient temperature<sup>39</sup>.

Higher temperatures increase exposure to bacterial and parasitic diarrhoea, and lengthen survival of bacteria such as enterotoxigenic *Escherichia coli* in contaminated food.

Lower temperatures increase the transmission of viral diarrhoea. At intermediate temperatures (18–23°C), children may be exposed to many viral, bacterial, and parasitic pathogens.

Health services may need to be better prepared to face changes in the epidemiology of diarrhoeal diseases by use of preventive public-health interventions during future *El Niño* episodes<sup>40,41</sup>.

### Conclusion and future prospective

Climate change is predicted to have substantial effect on human health. Especially, children are among the most vulnerable population groups and they are likely to disproportionately suffer negative health outcomes such as diarrhea diseases, one of the primary causes of child morbidity and mortality and was seen to be aggravated by climate change. For this reason further research, assessment and monitoring of child health in respect to climate change is critical. And such research, including surveillance and program evaluation, is essential to inform the prioritization of activities related to climate change adaptation in public health.

Furthermore, Prevention strategies for reduction or mitigation of greenhouse gas (GHG) levels in the global system are needed. And understanding of the effects of weather variability on the epidemiology of infectious diseases is important for planning of health services.

In order to tackle the challenge of global climate change and child health a concerted effort is required by national level this must involve all the relevant ministries concerned with environment, health, water, sanitation, education, statistics and social policy. At the international level, organizations concerned in this area should establish this issue as a priority and take actions accordingly. On this basis, a contribution can be made to address the overall health impacts of climate change, and to the promotion of children's needs and rights at both the national and global levels.

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